REMARKS

Status of the claims:

Claims 1-41 are pending. Claim 41 has been added. No new matter has been added by way of the above amendment. Support for claim 41 appears at page 14, lines 5-6, in the paragraph bridging pages 17 and 18, page 19, lines 18-19, page 21, lines 2-5, and page 54, lines 13-16. This response is not meant to supercede the response of January 16, 2003 but is merely made to supplement that response. Reconsideration is respectfully requested in light of the following remarks.

Conclusion

With the above amendments and remarks as well as the amendments and remarks in the response of January 16, 2003, it is believed that the claims, as they now stand, define patentable subject matter such that a passage of the instant invention to allowance is warranted. A Notice to that effect is earnestly solicited.

If any questions remain regarding the above matters, please contact Applicant's representative, T. Benjamin Schroeder (Reg. No. 50,990), in the Washington metropolitan area at the phone number listed below.

Attached hereto is a marked-up version of the changes made to the application by this Amendment.

[redacted]

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. §§ 1.16 or 1.17; particularly, extension of time fees.

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

Claim 41 has been added.

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For the Examiner's convenience, all of the pending claims, which are ready for further action on the merits are presented here.

1. (Twice Amended) A microorganism transformed with at least one recombinant DNA molecule encoding at least a part of an enzyme that causes the functional coupling of the oxidation and reduction of substrates by NAD/NADH- or NADP/NADPH-linked dehydrogenase reactions that share a common substrate and have different specificities for the NAD/NADH and NADP/NADPH coenzyme couples and so facilitates the transfer of electrons between NAD/NADH and NADP/NADPH couples through said substrates, said transformed microorganism thereby producing from carbohydrate a product more reduced than pyruvate more efficiently or with more benefits than does the corresponding non-transformed microorganism, with said benefits being selected from the group consisting of a cheaper process, a higher specific rate, a higher yield of product from carbohydrate, and smaller amounts of unwanted side products.

2. (Amended) A microorganism transformed with a recombinant DNA molecule that replaces the natural promoter of a host gene encoding an NAD/NADH- or NADP/NADPH-linked dehydrogenase by another promoter that causes stronger expression or expression

under different physiological conditions than said natural promoter and so causes the functional coupling of the oxidation and reduction of substrates by NAD/NADH- or NADP/NADPH-linked dehydrogenase reactions that share a common substrate and have different specificities for the NAD/NADH and NADP/NADPH coenzyme couples and so facilitates the transfer of electrons between NAD/NADH and NADP/NADPH couples through said substrates, said transformed microorganism thereby producing from carbohydrate a product more reduced than pyruvate more efficiently or with more benefits than does the corresponding non-transformed microorganism with said benefits being selected from the group consisting of a cheaper process, a higher specific rate, a higher yield of product from carbohydrate, and smaller amounts of unwanted side products.

3. (Amended) The microorganism of claims 1 or 2, said microorganism producing a product faster than does a corresponding non-transformed microorganism.

4. (Amended) The microorganism of claims 1 or 2, said microorganism producing less CO_2 per unit of a product produced than does a corresponding non-transformed microorganism.

5. (Amended) The microorganism of claims 1 or 2, said microorganism having a reduced oxygen requirement per unit of a product produced than has a corresponding non-transformed microorganism.

6. (Amended) The microorganism of claims 1 or 2, wherein said microorganism produces from carbohydrates a product more reduced than pyruvate while maintaining a higher metabolic capacity to convert carbohydrate into said product than does a corresponding non-transformed microorganism.

7. (Amended) The microorganism of claim 6, wherein the metabolic capacity of a corresponding non-transformed microorganism decreases with time.

8. (Amended) The microorganism of claims 1 or 2, wherein the product is ethanol.

9. The microorganism of claim 8, wherein the ethanol is derived from a pentose.

10. The microorganism of claim 8, wherein the ethanol is derived from a hexose.

17. (Twice Amended) The microorganism of claims 1 or 2, wherein at least one of the recombinant DNA molecules encodes an NAD/NADH- or NADP/NADPH-linked dehydrogenase or replaces the natural promoter of a host gene encoding an NAD/NADH- or NADP/NADPH-linked dehydrogenase.

18. The microorganism of claim 17, wherein the dehydrogenase is selected from the group consisting of glutamate dehydrogenases, malate dehydrogenases, malic enzymes and aldehyde dehydrogenases.

19. (Amended) The microorganism of claims 1 or 2, which microorganism is a yeast.

20. The microorganism of claim 19, which microorganism is a strain of *Saccharomyces* spp., *Schizosaccharomyces* spp. or *Pichia* spp.

21. (Amended) A microorganism of claim 9, which is a strain of *Saccharomyces* spp. Or *Schizosacharomyces* spp. expressing genes encoding xylose reductase and xylitol dehydrogenase, and which is transformed with at least one recombinant DNA molecule encoding an NAD/NADH- or NADP/NADPH-

linked dehydrogenase or replacing the natural promoter of a host gene encoding an NAD/NADH- or NADP/NADPH-linked dehydrogenase.

22. The microorganism of claim 21, which further expresses a gene encoding xylulokinase.

25. *Saccharomyces cerevisiae* strains selected from the group consisting of H1791 (VTT C-98298, DSM 12213), H1795 (VTT C-98300, DSM 12214), H1803 (VTT C-98302, DSM 12215), H2193 (VTT C-99317, DSM 12722), H2195 (VTT C-99320, DSM 12723) and H2222 (VTT C-99322, DSM 12724).

26. *Schizosaccharomyces pombe* strains selected from the group consisting of H2369 (VTT C-99323, DSM 12725) and H2370 (VTT C-99324, DSM 12726).

28. (Twice Amended) A method of producing useful products from carbohydrates, comprising the step of fermenting said materials with a microorganism of claims 1 or 2.

29. (Amended) The method of claim 28, wherein the carbohydrates comprise pentoses, pentose polymers or mixtures thereof.

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30. (Amended) The method of claim 28, wherein the carbohydrates comprise hexoses, hexose polymers or mixtures thereof.

33. The method of claim 28, wherein ethanol is produced.

38. (Amended) A method of producing ethanol from carbohydrates comprising pentoses, pentose polymers or mixtures thereof, comprising the step of fermenting said materials with a microorganism of claim 19.

39. (Amended) The microorganism of claims 1 or 2, wherein at least one of the recombinant DNA molecules encodes or causes the expression of a gene encoding a pyruvate carboxylase.

40. (New) A microorganism transformed with at least one recombinant DNA expression vector comprising a DNA molecule encoding a gene of at least one enzyme that facilitates the functional coupling of the oxidation and reduction of substrates by NAD/NADH-linked or NADP/NADPH-linked dehydrogenase reactions that share a common substrate and have different specificities for the NAD/NADH and NADP/NADPH coenzyme couples, said transformed microorganism producing one or more products from

carbohydrate more efficiently than does a corresponding non-transformed microorganism.

41. (New) The microorganism of claim 1 or 2, said microorganism producing more product per unit of carbohydrate in a raw material than does a corresponding non-transformed microorganism.